Ultrasound Evaluation of Wrist and Hand Pathology

Jon A. Jacobson, M.D.
Professor of Radiology
Director, Division of Musculoskeletal Radiology
University of Michigan

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Pathology:
• Joint effusion and synovitis
• Tendon abnormalities
• Nerve entrapment
• Ligament, cartilage, and osseous injury
• Cysts and masses

Joint Effusion:
• Radiocarpal joint
• Midcarpal joint
• Distal radioulnar joint

Joint Effusion versus Synovitis
• Anechoic and compressible = simple fluid
• If not anechoic:
  – Compressible, no hyperemia = complex fluid
  – Non-compressible, hyperemia = synovitis
• Sonography cannot differentiate sterile from septic joint fluid

AJR 2000; 174: 1353
**Effusion: radiocarpal joint dorsal recess**

- Sagittal plane: Radiocarpal and Mid-carpal Joints

**Inflammatory Arthritis: role**

- Identify synovitis and erosions
  - Prior to initiating treatment
- Determine activity: hyperemia
- Aspirate or inject
- Follow-up after therapy
  - Decreased hyperemia
  - Decreased synovial thickness

**Synovitis: US and MRI**

- Many studies limited
  - Clinical exam as gold standard
- Both US and MRI more sensitive compared to radiography
- Both can show activity of disease
  - US: color and power Doppler
  - MRI: enhancement

Backhaus M, Arthritis and Rheum 1999; 42:1232

**Rheumatoid Arthritis**

- Erosions
  - Cortex and subchondral bone plate: normally smooth and echogenic
  - Erosions:
    - Disrupted cortex, two planes
    - Adjacent synovitis
  - US better than radiographs
  - US false-positive rate compared to CT

Finzel S. et al. Arth Rheumatism 2011; 63:1231
Rheumatoid Arthritis

Erosions: US and MRI

- Many studies limited
  - Variable or absent gold standards
- MCP joints (CT as gold standard):
  - Radiography 19% sensitivity
  - MRI: 68% sensitivity
  - US: 42% sensitivity
- Limitations: access to erosions

Dohn UF M, Arthritis Res Ther 2006; 8:1

Pitfall Alert!

Pseudoerosion

- Metacarpal head: dorsal
- Up to 37% of metacarpal heads: 2nd most common
- Bare area: no hyaline cartilage
- Unlike erosion:
  - Smooth
  - Maximum depth: 2 mm
  - No adjacent synovitis

Boutry N. et al. Radiology 2004; 232:716

Pseudoerosion: dorsal metacarpal head

Radiology 2004; 232:716
Psoriatic Arthritis

- Radius
- Lunate
- Capitate

Dorsal: transverse
Dorsal: sagittal

Note: joint space narrowing and extensive bone proliferation

Erosions: specificity

- To add specificity to bone irregularity:
  - Correlate with history
  - Correlate with lab values
  - Review radiographs!
  - Look at distribution
  - Evaluate for adjacent synovitis (if acute)

Cortical Irregularity

- Psoriatic Arthritis
- Osteoarthritis
- Rheumatoid Arthritis
- Normal

Synovitis: screening (<10 minutes)

- Hand and wrist: (6 joints – actually 10)
  - Radiocarpal, midcarpal, distal radioulnar (dorsal)
  - MCP2 and 3 (dorsal): transverse and sagittal
  - Any symptomatic site
  - Cine: flexor and extensor tendons (short axis)
- Ankle and Foot:
  - Ankle joint
  - MTP5 (dorsal and plantar)
  - Any symptomatic site

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Tenosynovitis:

- Rheumatoid Arthritis
  - Extensor Tendons of Wrist

Tenosynovitis: lupus
- Short Axis
- Ulna
- Radius
- Color Doppler

Tenosynovitis: rheumatoid arthritis
- Short Axis
- Long Axis: color Doppler
- ECU
- ECU

Tenosynovitis + erosions: rheumatoid arthritis
- Ulna
- ECU

De Quervain Tenosynovitis:
- Stenosing tenosynovitis
  - Overuse, primary care givers
- 1st dorsal wrist compartment:
  - Extensor pollicis brevis + abductor pollicis longus
- Ultrasound findings:
  - Thick synovial sheath
  - Tendinosis
  - Cortical irregularity, hyperemia

Pitfall Alert!
Pseudo-tenosynovitis
- Extensor retinaculum
- Hypoechoic due to anisotropy
- Characteristic location
- Up to 1.7 mm thick and 23 mm in width
**Pitfall Alert!**
**Pseudo-tenosynovitis**
- Hypoechoic muscle
- Musculotendinous junction
- Confirmed in long axis
- Normal tapering of muscle

**Tendon Tear**
- Hypoechoic or anechoic
- Disruption of tendon fibers
- Retraction: full-thickness
  - Dynamic imaging

**Flexor Carpi Radialis**
- Courses volar to triscaphe joint (scapho-trapezium-trapezoid compartment)
- FCR tendinosis and tear
- Associated triscaphe osteoarthritis

**Extensor Pollicis Longus: tear**

**Pitfall Alert!**
**Pseudo-tendon Tear**
- Multiple tendon fascicles
- Abductor pollicis longus
  - Incidence: 80%
  - Up to 4 fascicles
- Extensor pollicis brevis
  - Incidence: 7%
  - Up to 2 fascicles
  - May be absent
- “Lotus Root Sign”
  - Seen best distal to radius

**Pitfall Alert!**
**Pseud-tendon tear**
- Extensor carpi ulnaris
- 6th extensor compartment
- Short axis: hypoechoic cleft
- Due to ground substance in between two heads of extensor carpi ulnaris

References:
- Parellada et al. Skelet Radiol 2006; 35:572
- Rousset et al. Radiology 2010; 257:427
- Choi et al. Radiology 2011; 260:480
- All S et al. Skelet Radiol 2015; 44:1735
- Chiavaras MM et al. AJR 2014; 203:531
Pulley Tear
• A2 and A4 pulleys: most important
• Sagittal image
  – Bowstringing
  – Hypoechoic edema / hemorrhage
• Dynamic evaluation*
  *Radiology 2002; 222:755

A2 – 4 Pulley Injury

A4 Pulley Injury: bowstringing

Trigger Finger:
• Stenosing tenosynovitis: A1 pulley
• Thick and hypoechoic pulley
• Hyperemia: 91%
• Tendinosis: 48%
• Tenosynovitis: 55%

Trigger Finger: A1 pulley

Trigger Finger: thumb
Extensor Carpi Ulnaris:
• 6th extensor wrist compartment
• Asymptomatic subluxation
  – Supination
  – Up to 50% out of groove
  – No tear or tenosynovitis

Lee KS et al. AJR 2009; 193:651

Dislocation: extensor carpi ulnaris

Short Axis

Pitfall Alert!
Pseudo-subluxation
• Extensor carpi ulnaris
• 6th extensor wrist compartment
• Asymptomatic subluxation
  – Supination
  – Up to 50% out of groove
  – No tear or tenosynovitis

Lee KS et al. AJR 2009; 193:651

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Carpal Tunnel Syndrome:
• Proximal median nerve swelling
  – Area: circumferential trace
  – Normal: <9 mm²
  – Borderline: 9 – 12 mm²
  – Abnormal: > 12 mm²
  • 12.8 mm² = moderate (83% sens, 95% spec)
  • 14.0 mm² = severe (77% sens, 100% spec)

Klauser AS et al. Sem Musculoskel Rad 2010; 14:487
Ooi et al. Skeletal Radiol 2014; 43:1387
Carpal Tunnel Syndrome

- Compare areas:
  - Proximal: pronator quadratus
  - Distal: carpal tunnel
- $= \text{or} > 2 \text{ mm}^2 = \text{carpal tunnel syndrome}
- 99% sensitivity
- 100% specificity

Klauser AS. Radiology 2009; 250:171

Carpal Tunnel Syndrome: distal

Carpal Tunnel Syndrome: ulnar bursa distention

Postoperative Carpal Tunnel

- Discontinuous or thickened transverse carpal ligament
- Anterior displacement of transverse carpal ligament
- Median nerve size:
  - May decrease
  - Does not correlate with success

Naranjo A et al. Scand J Rheum 2010; 39:49

Bifid Median Nerve

- Bilobed or two separate trunks
- Interposed persistent median artery
- Incidence: 2.8%

Propeck et al. AJR 2000;175:1721
**Bifid Median Nerve + CTS**
- Carpal tunnel syndrome\(^1\)
- Increase in cross-sectional area of \(\geq 4 \text{ mm}^2\)
- Intraneural hypervascularity: 95% accuracy in diagnosis of CTS\(^2\)

\(^1\)Klauser et al. Radiology 2011; 259; 808
\(^2\)Matsuhi et al. AJR 2006; 186:1240

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**Scapholunate Ligament Tear**
- Normal hyperechoic ligament not seen
- Abnormal hypoechogeticity
- Wide scapholunate space
- Dynamic imaging: fist clench

AJR 2002; 179:523

**Scapholunate Ligament**


**Dorsal Wrist: scapholunate ligament**

Axial T1w Transverse

**Scapholunate Ligament Tear**

At Rest Clench Fist

Normal
Gamekeeper’s Thumb

- Injury of the ulnar collateral ligament (UCL) of the thumb
  - Historically, chronic injury in Scottish gamekeepers
  - Frequently, due to acute MCP joint hyperabduction
  - Skier’s thumb: up to 86% of thumb base injuries

Ulnar Collateral Ligament: thumb

- Normal
- Sprain
- Partial Tear
- Nondisplaced Complete Tear
- Displaced Complete Tear (Stener Lesion)

Stener Lesion:

- Displaced proximal stump of torn UCL
  - Hypoechoic & round
  - Proximal to MCP joint
  - At proximal edge of adductor aponeurosis
- No tissue spanning MCP joint
- "Yo-yo on a string" sign

*Radiology 1995; 194:65
Stener Lesion: dynamic

White arrows = adductor aponeurosis
Yellow arrows = Stener lesion

Proximal Phalanx
1st Metacarpal

Normal


Stener Lesion

Proximal Phalanx
1st Metacarpal

Normal


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Soft Tissue Mass: wrist ganglia

• Most wrist masses are ganglion cysts
• Volar (69%):
  – Radial artery & flexor carpi radialis
  – Proximal from radioscaphoid joint capsule
• Dorsal: scapholunate ligament
  – Not compressible (unlike joint recess)

*Skeletal Radiol 1994; 23:201
Ganglion Cyst: dorsal

Ganglion Cyst vs Dorsal Recess

Ganglion Cyst: volar

Ganglion Cyst: volar

*Skeletal Radiol 1994: 23:201
**Ganglion Cyst: volar**

- Arises from DIP joint
  - Osteoarthritis
  - Pedicle
- Often extends to nail bed
- Subungual mass
- Middle-age or older women
- Recur

Baek HJ et al. Radiographics 2010; 30:1621

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**Mucous Cyst**

- Arises from DIP joint
- Osteoarthritis
- Pedicle
- Often extends to nail bed
- Subungual mass
- Middle-age or older women
- Recur

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**Soft Tissue Foreign Bodies**

- Wood and plastic: not radiopaque on radiographs
- All soft tissue foreign bodies are initially hyperechoic

Radiology 1998; 206:45

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**Sonography:**

- All foreign bodies: initially hyperechoic
  - Organic matter: less echogenic over time
- Most echogenic if ultrasound beam perpendicular to surface of foreign body

Radiology 1998; 206:45

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**US: foreign body echogenicity**

1. Hypoechoic halo: foreign body response
2. Smooth and flat: reverberation
3. Irregular and small radius of curvature: shadowing

Radiology 1991; 181:231
Wooden Foreign Body: finger

Longitudinal

MP MP DP

Foreign Body: wood

Longitudinal Coronal T2w

Radius

Giant Cell Tumor Tendon Sheath:
- Similar in histology to pigmented villonodular synovitis
- 2 forms:
  - Diffuse: florid or proliferative synovitis
  - Focal: nodular tenosynovitis
    - Most common form
    - Hand, volar digits #1 - 3

Jelinek. AJR 1994; 162:919

Giant Cell Tumor of Tendon Sheath

Transverse Parasagittal

Phalanx

Glomus Tumor:
- Hamartoma:
  - Neuromyoarterial glomus body
- 75% in hand: subungual
- Pain, tenderness, temperature sensitivity
- US:
  - Hypoechoic to isoechoic mass
  - Increased flow


Glomus Tumor:

Hamartoma:
  - Neuromyoarterial glomus body
  - 75% in hand: subungual
  - Pain, tenderness, temperature sensitivity
  - US:
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Take Home Points

- Arthritis: emphasize synovitis
- Nerve: swelling at entrapment site
- Stener:
  - Proximal to MCP joint and aponeurosis
  - Dynamic imaging
- Ganglion cysts: multilocular
  - Volar at FCR and radial artery
  - Dorsal over SL ligament

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